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Space in Language and Culture: Are the Representations Different?

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When we describe space we use two perspectives; survey perspective and route perspective. Many studies have shown that there are many differences between representations from survey perspective and the ones from route perspective. However, most of the research in this field is done in English and our knowledge in connection to space description and the Japanese language is extremely limited. Responding to this gap in knowledge, the present study proceeded in a comparison between data drawn from a Japanese and an English research focusing on space description. This comparison revealed two differences in spatial representations between Japanese and English speakers. Firstly, Japanese speakers have difficulties to form a spatial representation from the survey perspective and secondly, Japanese speakers are less able in processing locative information than English speakers. Factors such as language and culture are thought to be responsible for the differences. This study is not a direct comparison which can control extraneous variables, thus we cannot locate the contribution factor. Many hypotheses are possible which include factors such as linguistic, cultural, environmental, and racial ones.

INTRODUCTION

We always live in a space, therefore it is very important for us to describe and represent the space which surrounds us. Without this knowledge, we are unable to go anywhere and we cannot navigate someone to his or her destination. Space is typically described from two perspectives; survey perspective and route perspective. A survey perspective takes bird's eye view and adopts reference terms which are based on the environment such as north, south, east and west while it employs static verbs such as 'be' (Levinson, 1996). An example of this perspective is knowledge in the form: The library is south of the School of Education building. On the other hand, route perspective takes the viewpoint of an imagined navigator and adopts reference terms with respect to the navigator such as front, back, left and right. It also employs more active verbs such as 'see' or 'go'. An example of this perspective is the following: When you get out of the School of Education and after you turn to the right you will find the library in front of you. Both perspectives are used in Japanese and in English (Ohgishi, 2008). Taylor & Tversky (1992) who defined these two perspectives as part of the spatial mental models paradigm claim that spatial mental models are more abstract than images (cognitive maps) which are restricted to a specific point of view. According to Taylor & Tversky (1992) spatial mental models are more abstract than cognitive maps. Spatial mental models are invented to confront to the distortions in

spatial representation which cognitive maps cannot explain (Holyoak & Mah, 1982; Steven & Coupe, 1978).

Many subsequent studies adopted the spatial mental models paradigm. Brunyé & Taylor (2008b) and Shelton & McNamara suggest that the switching of perspectives increases the mental load[1] when study times are insufficient. Shelton & Gabrieli (2002) imply that there is a possibility that the two perspectives share a part of the mental processing system. Most of their findings propose that the survey perspective can operate spatial representations with less mental load than the route perspective.

Despite their findings, little has been reported concerning the spatial mental models paradigm in connection to Japanese because most of the research in this area is conducted in English (Ohgishi, 2008). Hence, there is the possibility that spatial representations of the same environment that adopt the same perspective may differ between languages. In fact, Takai (2006) pointed out that culture differences may have an effect on spatial cognition. Thus, it is reasonable to assume that culture has an effect on one's spatial representation too. In this sense, the purpose of this study is to investigate the effect of language and culture on spatial representations by comparing the results of spatial mental models studies in Japanese and in English.

METHOD

The experiment in Japanese has been conducted similarly to the one conducted in English by Brunyé & Taylor (2008b). In addition any unrelated conditions were controlled.

Experiment design

The experiment was 2 (study perspective: survey/route) x 2 (consistency between the study and the test: within/across) design about spatial representation and 2 (study perspective: survey/route) x 2 (test type: locative and non-locative) design about declarative memory[2]. All participants have been tested in all the conditions and all the experiments were conducted in Japanese.

Participants

40 students (20 males and 20 females) participated in the experiment. The average age of the participants was 21.5yrs (SD = 2.28).

Materials

We used sentence-stimuli and a statement verification task. Sentences related to the town and to the convention-center were translated into Japanese from the Taylor & Tversky (1992) and were used as stimuli. The landmarks which were unfamiliar to the

Japanese were renamed into more familiar ones. The sentences were presented automatically on a PC screen one by one. The presentation time was determined after a preliminary examination of 8 other participants. In the preliminary examination, participants were told to read the sentences as fast as they could in order to answer the questions afterward. The average presentation time was 6.21sec per sentence (MIN 1.84sec, MAX 11.96sec, $SD = 2.28$).

The statement verification task consisted of 28 'true' or 'false' questions. More specifically, there were: Four non-locative statements (verbatim), four non-locative statements (paraphrased), four survey questions (verbatim), four route statements (verbatim), six survey statements (inference) and six route statements (inference). In every category, there were three true statements while the rest were false. Even when a survey or route statement was presented, it was categorized into declarative memory if the study-sentences were presented in the same perspective. We measured the declarative memory in order to gain insight about any possible differences between declarative memory with locative information and declarative memory without locative information. Participants also completed a map drawing task, but this will not be discussed here.

Procedure

Firstly, participants read the sentence about the town or the convention center in either survey or route perspective. Secondly, they responded to true or false questions. Finally, they were instructed to draw a map which they had learned. Then they learned the other environment from the other perspective, answered questions, and drew a map.

RESULTS

We conducted 2 (study perspective: survey/route) x 2 (consistency between the study and the test: within/across) ANOVA on the response time for the statement verification task about spatial representation. As a result, the main effect of study perspective was non-significant ($F(1,39) = 0.044$ *n.s.*, $\eta_p^2 = .00$). That of consistency between the study and the test was significant ($F(1,39) = 21.791$, $p < .001$, $\eta_p^2 = .36$) and it showed shorter response time in within condition than in across condition. The interaction between study perspectives and consistency showed significance ($F(1,39) = 53.938$, $p < .001$, $\eta_p^2 = .58$). In survey study conditions this interaction showed shorter response time in consistent condition than in inconsistent condition ($F(1,39) = 55.033$, $p < .001$, $\eta_p^2 = .59$). In route study conditions consistent condition increased the response time compared with inconsistent condition ($F(1,39) = 7.998$, $p < .01$, $\eta_p^2 = .17$). Also in consistent conditions survey study decreased the response time ($F(1,39) = 20.313$, $p < .001$, $\eta_p^2 = .34$). In inconsistent conditions route study decreased the response time ($F(1,39) = 14.770$, $p < .001$, $\eta_p^2 = .28$).

In addition, we conducted 2 (study perspective: survey/route) x 2 (test type: locative/non-locative) ANOVA on the response time of statement verification task about declarative memory. The main effect of study perspective was non-significant. ($F(1.39) = .124$, *n.s.*, $\eta_p^2 = .00$), That of test type was significant ($F(1,39) = 58.592$, p

$< .001$, $\eta_p^2 = .60$) and it showed longer response time to locative test than in non-locative test. The interaction effect was non-significant ($F(1,39) = 1.684$, *n.s.*, $\eta_p^2 = .04$).

Statement verification (Accuracy)

We conducted 2 (study perspective: survey/route) x 2 (consistency between the study and the test: within/across) ANOVA on the accuracy of statement verification task about spatial representation. As a result, the main effect of study perspective and consistency were non-significant ($F(1,39) = 2.007$, *n.s.*, $\eta_p^2 = .05$ $F(1,39) = 0.003$, *n.s.*, $\eta_p^2 = .00$). The interaction between study perspectives and consistency showed significance ($F(1,39) = 36.552$, $p < .001$, $\eta_p^2 = .48$). In survey study conditions this interaction showed higher accuracy in consistent condition than in inconsistent condition ($F(1, 39) = 19.147$, $p < .001$, $\eta_p^2 = .33$). In route study conditions consistent condition decrease accuracy compared with inconsistent condition ($F(1,39) = 13.410$, $p < .001$, $\eta_p^2 = .26$). And in consistent conditions, survey study promote the accuracy ($F(1,39) = 13.785$, $p < .001$, $\eta_p^2 = .26$). In inconsistent conditions route study promote the accuracy ($F(1,39) = 5.235$, $p < .05$, $\eta_p^2 = .12$).

Similarly to the response time, we conducted 2 (study perspective: survey/route) x 2 (test type: locative/non-locative) ANOVA on the accuracy of statement verification task about declarative memory. The main effect of study perspective was non-significant. ($F(1.39) = 0.813$, *n.s.* , $\eta_p^2 = .02$). That of test type was significant ($F(1,39) = 30.159$, $p < .001$, $\eta_p^2 = .44$) and it showed higher accuracy to locative test than in non-locative test. The interaction effect was non-significant ($F(1,39)=0.494$, *n.s.*, $\eta_p^2 = .01$).

Differences between the Japanese and English findings

The response time and the accuracy showed nearly the same tendency, and therefore we will show only the response time data and discuss response time and accuracy together.

There are two differences between the findings of this study and the English ones. The first one is the increase of the mental load in the survey study as Fig.1 shows (especially in route test). This demonstrates that the Japanese speakers answered the question with longer response time and lower accuracy than the English speakers when they studied the environment from the survey perspective. The second difference is the fact that the locative test demands more mental load than non-locative test as shown in Fig. 2. This illustrates that Japanese speakers answered the locative question with longer response time and lower accuracy than English speakers. Statistical tests were not performed on these comparisons. In my opinion, however, judging from the difference of the average response time and standard deviation, the statistical test would have shown significant difference and large effect size between these two languages.

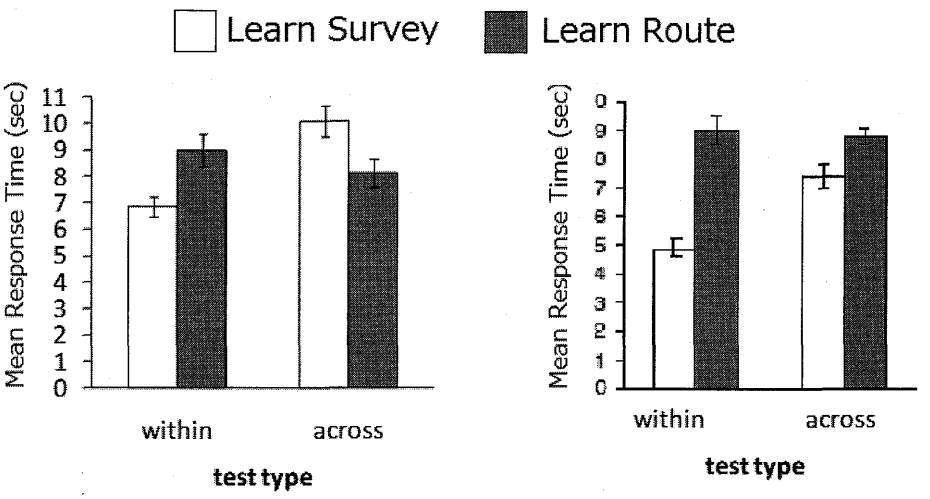

Fig. 1 Mean response time in Japanese results and English ones about spatial representation

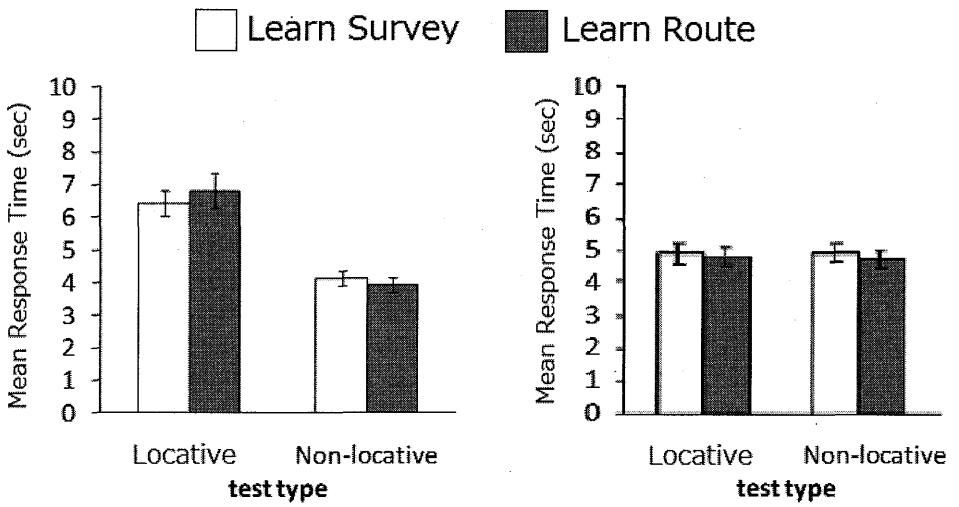

Fig. 2 Mean response time in Japanese results and English ones about declarative memory

DISCUSSION

Our discussion is focused on the comparison of the differences between the Japanese findings and the English ones, although a statistical test about these differences was not conducted.

The mental load increase in survey study

In the Japanese findings, the mental load in survey study exceeds that in the English ones. According to Ohgishi (2008), two differences between Japanese and English might be responsible for the difficulty of survey study.

The first difference is the fact that, unlike English, in Japanese we do not always use pronouns such as 'I', 'we', and 'you' explicitly. Instead, we use them tacitly and the listener has to make inferences about what the subject of the sentence is. In daily life, when one says 'Pass me the right scissors' the listener often gets confused with the word 'right'. This is because there is no explicit verbal cue in order to distinguish if 'right' is the 'speaker's right' or the 'listener's right'. In the English route test the pronoun was presented explicitly in the statement and it was obvious to the participants. On the contrary, in the Japanese route test the pronoun was not presented explicitly. Thus, participants needed to provide the viewpoint of the new subject in the test phase and exhibit a greater mental load, if the condition was survey study and route test, in which they did not have an imaginary agent in the study phase. Therefore we may assume that the necessity to create the new imaginary agent in our minds can increase the response time and reduce the accuracy of our response. We can test this possibility by adding the word 'you' in Japanese route test condition. If it does not damage the readability of the sentence and if it decreases the gap between the Japanese results and the English results, the above hypothesis is supported.

The second difference between English and Japanese is the fact that the Japanese speakers do not use relative pronouns and this makes the building of hierarchical structure and survey study difficult. When we take into account the fact that not only in inconsistent condition but also in consistent condition survey study, there is an increase of mental load, this hypothesis may explain the difference between Japanese and English more sufficiently. Unlike the one sentence statement verification test, in which spatial representation is studied through long text, hierarchical structure might support the construction of the spatial representation. Because long text contains a lot of information, it will need an easy way to understand the text with less mental load. Hierarchical structure which derives from relative pronoun may be one way to do that.

In Japanese, we cannot make use of the hierarchical structure and this increases the mental load in survey study when we need inference.

The mental load increase in location test

We can interpret this phenomenon in two ways.

The first one is the familiarity of the participants with the environment. The text in this experiment is a translation of a preceding study in English. Therefore, it is possible that these environments were not familiar or suitable for the Japanese participants who live in the Japanese environment. The unfamiliarity and unsuitability might make it difficult to process spatial information. In other words, the plausible spatial structure changes according to their daily environment. Unlike cities in the West, Japanese streets seldom do have names.[3] In addition, they are not as straight as in the West because of the mountainous land surface of the country. It is possible that these differences have different effects on the representations formed by the participants. We can test this hypothesis in a 2 by 2 factors experiment. The first factor is the language of the participants (Japanese/English) and the second factor is

the environment (in the East/in the West). If participants show shorter response time and higher accuracy in experiments concerning their own environment, then we can claim that familiarity with the environment is an important factor for the construction of spatial representations.

The second one is the verbal and/or cultural poorness of the Japanese language in processing spatial information. The low results in the statement verification test support this possibility. If the Japanese participants show lower performance regardless of the environment in the experiment designed above, this hypothesis will be supported.

CONCLUSION

As stated above, there are some possible differences in spatial cognition between Japanese speakers and English speakers and for each difference a certain hypothesis can be proposed.

This study can contribute to the discussion of the effect of language on human spatial representation by illustrating the differences in spatial representations between Japanese speakers and English speakers. This study, however, is not a direct comparison between different languages but a comparison of different studies. Therefore, we can hypothesize but we cannot specify the causes of the differences. We need future studies that will be able to control the extraneous factors in order to investigate the causes of the differences (e.g. verbal factor vs. cultural factor). By investigating these causes, we will be able to further understand spatial representation and the role of language and any other possible factors in this process.

However, there are further complexities that need to be researched. The first is the interaction between factors. People construct their environment, access and refer to it using language. Objects in our environment and perhaps the environment itself are related to language. Therefore, we are inclined to assume that language might be the main factor which affects other 'factors'. In other words, the language factor may cause other 'factors' to work as if they were factors. The second complexity is the attitude and the wish of the participants to 'do well' in the test. In fact, it might be the case that cultural or environmental factors, such as the anxiety during tests, have an effect on the performance of the participants.

In this study, Japanese speakers were university students in Japan. In the case of the English study, participants were coming from the U.S. In this sense we also have to distinguish between English speakers in the U.K. and those in the U.S. because British and Americans use almost the same language but the culture and the structure of their environments may be different.

NOTES

1 In this study, the term 'mental load' means the amount of effort the participants put in order to represent a space or answer the question. When a participant needs more 'mental load', it is thought that the response time is longer and the accuracy is lower.

2 In this study, the term 'declarative memory' refers to a memory without spatial inference. Sentences containing spatial information were categorized under declarative even if the same sentences appeared in the study phase. The reason for this is that in this case spatial inference is

not needed in order to answer the question and therefore spatial representation is not required. What is needed is the memory of the sentence. A sentence without spatial information is of course also categorized under declarative memory.

3 Kyoto, where I conducted this study, is an exception.

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